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the documents annexed hereto are true copies of:

Application forms P.1 and P.2, provisional specification and drawing  
of South African Patent Application No. 2001/5463 as originally  
filed in the Republic of South Africa on 3 July 2001 and post-dated  
to 3 January 2002 in the name of NXCO INTERNATIONAL LIMITED for  
an invention entitled: "JET MATERIAL ENHANCED SHOCKWAVE".

Geteken te  
Signed at

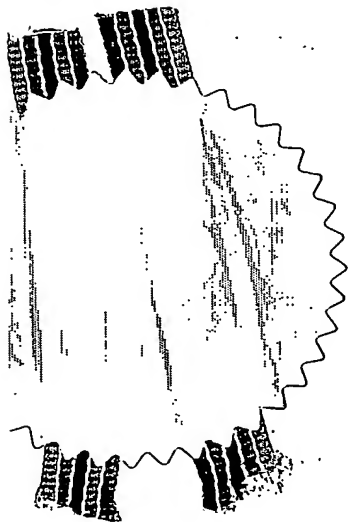
PRETORIA

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PATENTS ACT, 1978

*Post-dated*  
REGISTRAR OF PATENTS

Official Application No.		Lodging date: Provisional		Acceptance date:	
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International classification		Lodging date: Complete		Granted date:	
51		23			

Full name(s) of applicant(s)/Patentee(s)

71 NXCO INTERNATIONAL LIMITED

Applicant(s) substituted:

Date Registered:

71		

Assignee(s):

Date Registered:

71		

Full name(s) of inventor(s)

2 To be advised

Priority claimed	Country		Number		Date	
Note:	33	NONE	31	NONE	32	NONE
Use International	33		31		32	
Abbreviation for Country	33		31		32	

Title of Invention:

1 JET MATERIAL ENHANCED SHOCKWAVE

Address of applicant(s)/patentee(s)

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McCALLUM, RADEMEYER & FREIMOND, Maclyn House, June Avenue, Bordeaux, Randburg • P.O. Box 1130, Randburg 2125

Patent of Addition No.

Date of any change:

Fresh Application based on:

Date of any change:

REPUBLIC OF SOUTH AFRICA  
PATENTS ACT, 1978

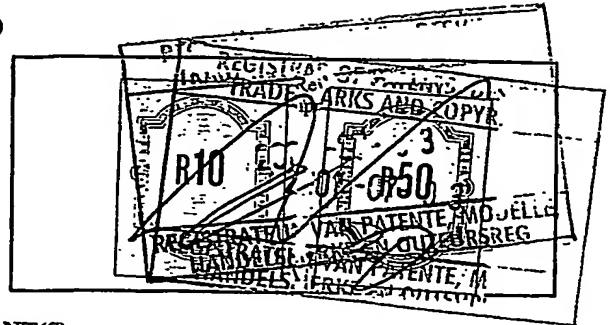
APPLICATION FOR A PATENT AND ACKNOWLEDGEMENT OF  
RECEIPT

(Section 30(1) - Regulation 22)

The grant of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate

OFFICIAL APPLICATION NO.

21	01	20015463
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FULL NAME(S) OF APPLICANT(S)

71	NXCO INTERNATIONAL LIMITED
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ADDRESS(ES) OF APPLICANT(S)

Saffrey Square, Suite 205, Bank Lane, Nassau, Bahamas
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TITLE OF INVENTION

54	JET MATERIAL ENHANCED SHOCKWAVE
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Priority is claimed as set out on the accompanying Form P2.  
The earliest priority claimed is :

This application is a patent of addition to Patent Application No.	21	01	
This application is a fresh application in terms of section 37 and based on Application No.	21	01	

THIS APPLICATION IS ACCOMPANIED BY:

- |                                     |    |  |
|-------------------------------------|----|--|
| <input checked="" type="checkbox"/> | 1  | A single copy of a provisional specification of 10 pages                 |
| <input type="checkbox"/>            | 2  | Two copies of a complete specification of ..... pages                    |
| <input checked="" type="checkbox"/> | 3  | 11 sheets of Informal Drawings   |
| <input type="checkbox"/>            | 4  | ..... sheets of Formal Drawings  |
| <input type="checkbox"/>            | 5  | Publication particulars and abstract (Form P8 in duplicate)              |
| <input type="checkbox"/>            | 6  | A copy of Figure ..... of drawings (if any) for the abstract             |
| <input type="checkbox"/>            | 7  | Assignment of Invention  |
| <input type="checkbox"/>            | 8  | Certified priority document(s) Number(s)                                 |
| <input type="checkbox"/>            | 9  | Translation of priority document(s)                                      |
| <input type="checkbox"/>            | 10 | An assignment of priority rights   |
| <input type="checkbox"/>            | 11 | A copy of the Form P2 and the specification of SA Patent Application No. |
| <input type="checkbox"/>            | 12 | A declaration and power of attorney on Form P3                           |
| <input type="checkbox"/>            | 13 | Request for ante-dating on Form P4                                       |
| <input type="checkbox"/>            | 14 | Request for classification on Form P9                                    |
| <input checked="" type="checkbox"/> | 15 | Form P2 in duplicate   |

21	01	
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Dated this 3<sup>rd</sup> day of July 2001.

McCALLUM, RADEMEYER & FREIMOND  
PATENT AGENTS FOR APPLICANT(S)

REGISTRAR OF THE COURT OF THE COMMISSIONER OF PATENTS
3.1.2002 2001-07-03
PATENTS OFFICE REPUBLIC OF SOUTH AFRICA

REPUBLIC OF SOUTH AFRICA  
PATENTS ACT, 1978

PROVISIONAL SPECIFICATION

(Section 50(1) - Regulation 27)

OFFICIAL APPLICATION NO

21	01	20015463
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LODGING DATE

22	3.1.2002 <del>3 JULY 2001</del>
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*Post-dated*

FULL NAME(S) OF APPLICANT(S)

71	NXCO INTERNATIONAL LIMITED
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FULL NAME(S) OF INVENTOR(S)

72	To be advised
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TITLE OF INVENTION

54	JET MATERIAL ENHANCED SHOCKWAVE
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### BACKGROUND OF THE INVENTION

This invention is concerned generally with a customized low energy method of breaking rock in a controlled manner.

5 As used herein the word "rock" includes rock, ore, coal, concrete and any similar hard mass, whether above or underground which is difficult to break or fracture. It is to be understood that "rock" is to be interpreted broadly.

10 A number of techniques have been developed for the breaking of rock using non-explosive means. These include a carbon dioxide gas pressurisation method (referred to as the Cardox method), the use of gas injectors (the Sunburst technique), hydrofracturing and various methods by which cartridges containing energetic substances pressurise the walls or base of a sealed drill hole to produce penetrating cone fractures (known as PCF).

15 These techniques may be an order of magnitude more efficient than conventional blasting in that they require approximately 1/10 of the energy to break a given amount of rock compared to conventional blasting using high explosives. The lower energy reduces the resulting quantity of fly rock and air blast and to an extent allows the rockbreaking operation to proceed on a continuous basis as opposed to the batch-type situation, which prevails with conventional blasting.

Most non-explosive rockbreaking techniques rely on the generation of high gas pressures to initiate a tensile fracture at the bottom of a relatively short drill hole.

5 The aforementioned techniques generally rely on the generation of high gas pressures to initiate a tensile fracture at the bottom of a drill hole. It is desirable, nonetheless, for a variety of reasons to be able to initiate fracture of the rock at a predetermined location which is not, necessarily, at the bottom of the drill hole.

#### SUMMARY OF INVENTION.

10 The invention provides a method of breaking rock which includes the steps of:

- (a) loading a cartridge into a hole in a rock face;
- (b) initiating a propellant in the cartridge thereby to cause the release of pressurised material by the propellant; and
- (c) generating a high pressure jet of a second material which has a density  
15 which is greater than the density of the pressurised material.

Stemming material of any appropriate kind may be placed in the hole over the cartridge in a manner which is known in the art.

20 The cartridge may be used to confine the pressurised materials in the cartridge whereby the cartridge is expanded into sealing engagement with a wall of the hole surrounding the cartridge so that, initially, the cartridge reinforces the wall of the hole.

To allow the aforementioned sealing engagement of the cartridge with the wall of the hole the cartridge may be made from a malleable material. "Malleable" in this sense includes a material which is capable of plastic deformation, without fracture, at least to the point at which the cartridge is in close contact with the surrounding wall of the hole.

The cartridge, when it fractures, allows the high pressure materials to initiate rock breakage.

The high pressure jet of the second material may be generated at one or more predetermined positions in the cartridge.

The high pressure jet of the second material may be generated by the action of the pressurised material, released in step (b), on at least one member which includes the said second material.

Alternatively or additionally to the foregoing the high pressure jet of the second material may be generated by the action of an explosive on at least one member which includes the said second material.

The explosive may be detonated by the action of the pressurised material which is released in step (b) or it may be directly detonated by suitable control means substantially at the same time as the blasting agent is initiated or slightly before or slightly after the time at which the blasting agent is initiated.

The invention also extends to apparatus for breaking rock which includes a cartridge which forms an enclosure, a propellant inside the enclosure, means for igniting the propellant, and at least one member, which is made from a material which has a density greater than the density of the blasting agent, on or inside the cartridge.

The density of the said member should, within reason, be as high as possible. For example iron has a density of the order of 7,8 and other metals or substances have densities in excess of this. Lead for example has a density of approximately 11,3. Uranium has a density of the order of 19. These substances are given merely by way of example as being suitable for use in the apparatus of the invention. In the last mentioned case it is preferable to make use of uranium in its depleted form to minimise radioactivity consequences.

The said member may be positioned at a predetermined point inside the cartridge.

The member may be turned into a high pressure jet by the action of the blasting agent when it is ignited. Alternatively or additionally an explosive which acts directly on the said member may be used to generate a high pressure jet of the material.

The said means which is used for igniting the blasting agent may be used for detonating the explosive. Alternatively a separate initiator is used for

detonating the explosive independently of the means which is used for igniting the blasting agent.

5 As used herein "blasting agent" is to be interpreted broadly to include a propellant, blasting agent, gas-evolving substance or similar means which, once initiated, generates high pressure material typically at least partly in gaseous form. Blasting agents of this type are known in the art. "Blasting agent" and "propellant" are used interchangeably in this specification.

#### BRIEF DESCRIPTION OF THE DRAWINGS

10 The invention is further described by way of examples with reference to the accompanying drawings in which:

Figure 1 is a side view in cross section of apparatus for breaking rock according to a first form of the invention, and

Figure 2 is a side view in cross section of apparatus for breaking rock according to a second form of the invention.

#### DESCRIPTION OF PREFERRED EMBODIMENTS

15 Figure 1 of the accompanying drawing illustrates a hole 10 which is drilled into a rock mass 12 from a face 14 using conventional drilling equipment, not shown. The hole is drilled to a length which is at least of the order of four times the nominal diameter of the hole.

A cartridge 16 is loaded into the hole. In this example the cartridge has a base 18 and a wall 20 which extends upwardly from the base. The cartridge has an upper rounded or domed-shaped end 22.

At least the wall 20 is made from a malleable material which, as used herein, means a material which is capable of plastic deformation, without rupture, at least to a predetermined extent.

The cartridge 16 forms an enclosure for a propellant material 24 which is of known composition and which is loaded into the cartridge under factory conditions using techniques which are known in the art. An initiator 26 is loaded into the cartridge. The initiator may be located at the rounded upper end 22 but this is by no means limiting and the initiator can be loaded into the cartridge at any appropriate point of the cartridge.

Control wires 28 lead from the initiator to a unit, not shown, which is used in a known manner for initiating the blasting process.

Stemming 30 is placed into the hole 10 from the rock face 14 in order to cover the cartridge to a desired extent. The stemming is tamped or otherwise consolidated in position. The nature of the stemming and its manner of use are known in the art and for this reason are not further described herein. It is to be noted that it is desirable for the base 18 to be in close contact with a bottom 34 of the hole.

Two ring-shaped inserts 36 and 38 are positioned inside the cartridge. The insert 38 rests on the base 18 while the insert 36 is positioned at a predetermined intermediate location. The insert is kept in position by means of a suitable adhesive or alternatively is frictionally engaged with an inner surface of the wall 20. Any other appropriate technique can be used to secure the insert at a desired position inside the cartridge.

The inserts 36 and 38 are made from a material which has a density greater than the density of the propellant 24. Ideally the density of each insert should be as high as possible under the circumstances. The inserts can be made from any appropriate substance which does not have undesirable side effects. For example the inserts can be made from lead or a composition which contains any other heavy metal which is not harmful. It is also possible to make use of depleted uranium, a dense substance which has a reduced radioactivity level.

Ignition of the propellant 24 by the initiator 26 causes the release of high pressure jet material which is substantially in gaseous form and which is directly generated by the combustion of the propellant. The cartridge 16 is designed to contain the expanding high pressure material initially in that it is allowed to deform outwardly without rupturing, so that the wall of the cartridge is forced into close sealing contact with an opposing surface 40 of the wall of the hole. The cartridge does not initially fracture for, as noted, it is fabricated from a plastically deformable material.

The cartridge confines the high pressure gas released by the propellant 24. During this process the inserts 36 and 38, at least to a substantial extent, remain integral.

5 The pressure shock wave which is generated by ignition of the propellant 24 advances through the cartridge. The insert 36 deforms the shock wave and this results in a high energy region being established at the locality of the insert. This, in itself, helps to cause the rock to crack once the cartridge fractures as the pressure inside the cartridge builds up to a predetermined point.

10 At the base of the cartridge the insert 38 also causes wave deformation and, in a manner similar to what has been described, this gives rise to a high pressure region more or less at the junction of the side wall with the base 18. A further factor comes into play in that the junction of the wall 20 with the base 18 is discontinuous and this further promotes the generation of localised high pressures which subsequently cause fracturing of the rock in the region of the interface between the bottom 34 and the side wall 40 the hole.

15

20 When the cartridge fractures each insert 36 and 38 disintegrates, thereby producing a high pressure jet of material which is directed into the adjacent rock surface. This high pressure jet is of a material with a density which is significantly greater than the density of the propellant 24 or, for that matter, than the density of the material from which the cartridge is made. This latter material is usually a plastics material. Each insert thus gives rise to a high

pressure jet of massive material which has considerable rock breaking capability.

It follows that by correctly positioning and shaping the inserts it is possible to initiate cracking of the rock at a chosen position.

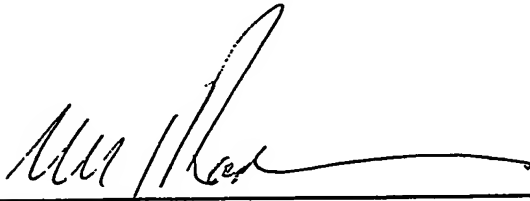
5 The apparatus shown in Figure 2 bears substantial similarities to what is shown in Figure 1 and where applicable like components are designated by means of like reference numerals. Again use is made of two inserts designated 36A and 36B respectively which are made from a suitable high density material. Each insert has a small explosive charge 50A and 50B  
10 respectively which is packed in close contact with the insert.

When the propellant 24 is ignited the explosive charges are detonated as the shock wave advances through the propellant. In each case the explosive charge helps to disintegrate the heavy metal insert thereby producing a localised high pressure jet of material which is effective at initiating fracture of  
15 the adjacent rock. It is to be borne in mind that the effect of the explosive is enhanced by the ability of the insert and the explosive, prior to detonation, to deform the shock wave which is generated by the combusting propellant.

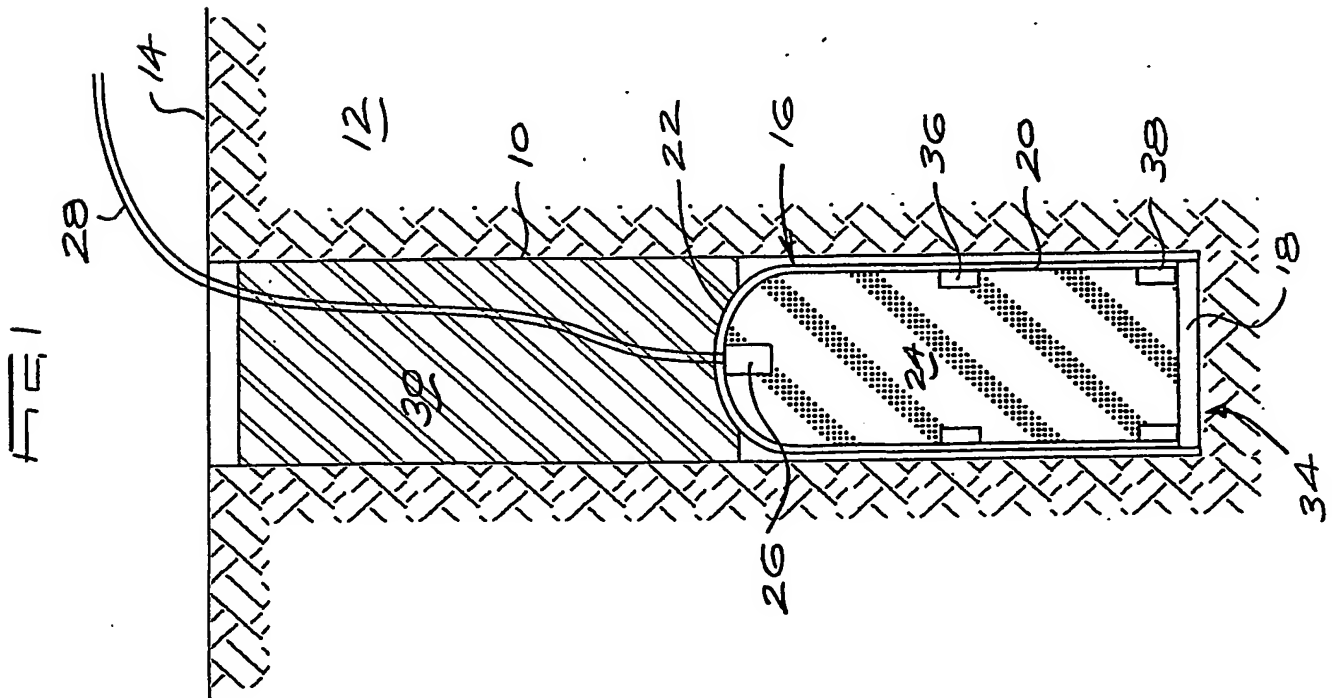
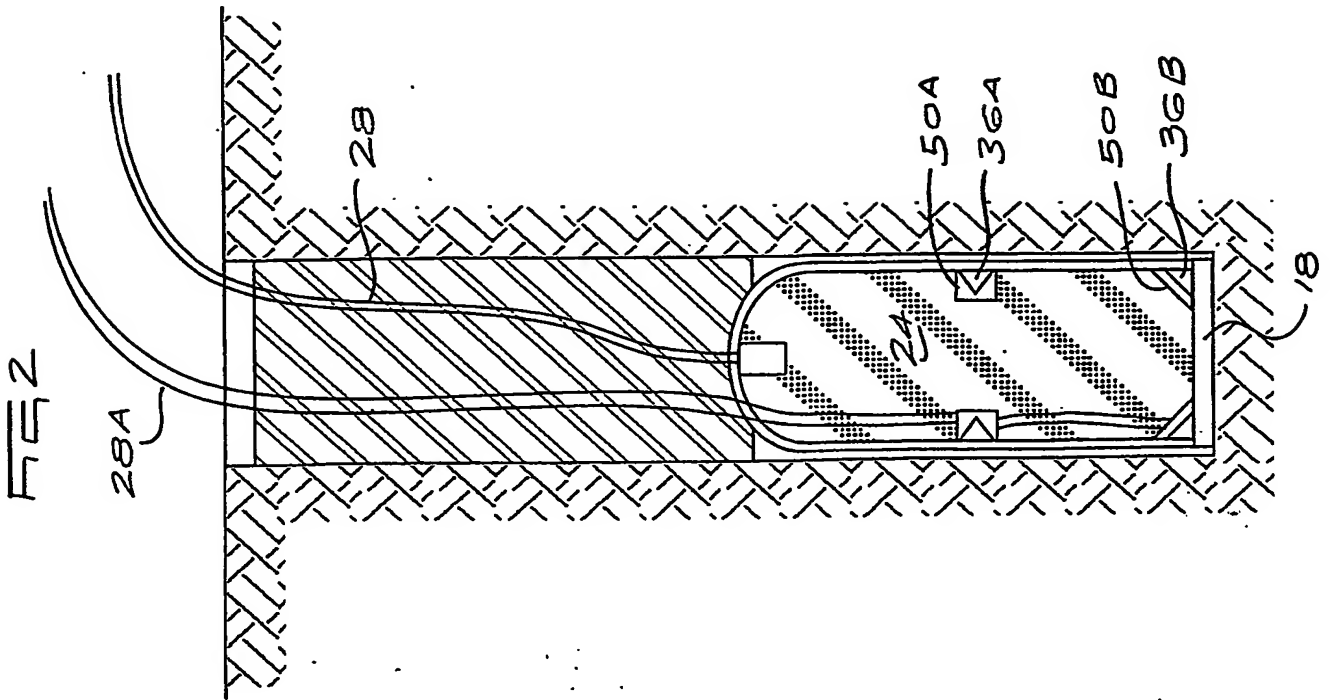
It is possible to ignite the explosive charges by sending an appropriate control signal directly to the charges. Optionally, if necessary, use could be made of  
20 a local detonator at the explosive charges. The control signal can be transmitted via a control wire 28A which is directly electrically connected to the control wires 28. Alternatively separate control signals can be sent on the

control wires 28 and 28A in order to detonate the explosive charges at a predetermined time relatively to the time at which the propellant 24 is ignited.

Dated this 3<sup>rd</sup> day of July 2001.



McCALLUM, RADEMEYER & FREIMOND  
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